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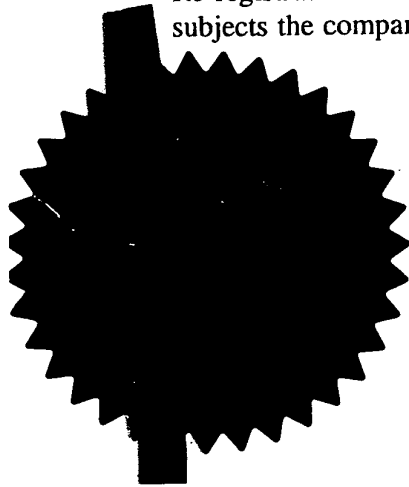
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I also certify that the attached copy of the request for grant of a Patent (Form 1/77) bears an amendment, effected by this office, following a request by the applicant and agreed to by the Comptroller-General.

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*R. Mahoney*

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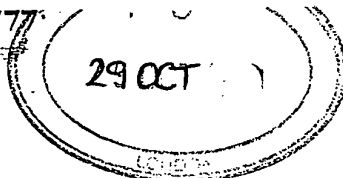
Dated 15 November 2000

GB9925643.0

By virtue of a direction given under Section 30 of the Patents Act 1977, the application is proceeding in the name of

**EXXONMOBIL RESEARCH AND ENGINEERING COMPANY,**  
Incorporated in USA - Delaware,  
P.O Box 390,  
180 Park Avenue,  
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New Jersey 07932-0390,  
United States of America

[ADP No. 07815939001]



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The Patent Office

Cardiff Road  
Newport  
Gwent NP9 1RH

1. Your reference P1999S007

2. Patent application number  
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9925643.0

3. Full name, address and postcode of the or of each applicant (underline all surnames)

EXXON RESEARCH AND ENGINEERING COMPANY  
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180 PARK AVENUE  
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UNITED STATES OF AMERICA

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

DELAWARE, USA

APPLICATION FILED 2/11/00  
439862001

4. Title of the invention

FUEL OIL COMPOSITIONS WITH IMPROVED COLD FLOW PROPERTIES

5. Name of your agent (if you have one)

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

FLETCHER WATTS, Susan Jane;  
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6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number  
(if you know it)

Date of filing  
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
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8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

YES

- a) any applicant named in part 3 is not an inventor, or
  - b) there is an inventor who is not named as an applicant, or
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Description	6
Claim(s)	3
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Statement of inventorship and right to grant of a patent (Patents Form 7/77)	3
Request for preliminary examination and search (Patents Form 9/77)	1
Request for substantive examination (Patents Form 10/77)	0
Any other documents (please specify)	0

11. I/We request the grant of a patent on the basis of this application.

Signature Susan J. Fletcher Watts Date 29 OCT 99

SUSAN JANE FLETCHER WATTS

12. Name and daytime telephone number of person to contact in the United Kingdom
- TRICIA LEMPRIERE  
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DUPLICATE

## **FUEL OIL COMPOSITIONS WITH IMPROVED COLD FLOW PROPERTIES**

This invention relates to fuel oil compositions, especially middle distillate fuel oil compositions, with improved flow properties.

It is important that fuel oil compositions, especially middle distillate oil compositions such as automotive diesel oils, heating oils and gas oils (hereafter collectively referred to as "fuel oil" for convenience) retain their flow properties at relatively low temperatures. The main cause of such loss of flow properties is due to the formation of wax which tends to precipitate out and agglomerate thereby plugging burner and vehicle fuel filters and hence impairing flow. The temperature at which the wax starts to appear is termed the cloud point of the fuel. The cold filter plugging point (CFPP) is recognised as a measure of the operability of a fuel and the temperature at which a fuel will start to block vehicle filters. It is generally less than or equal to the cloud point of the fuel. This problem has been well recognized in the art and has hitherto been mitigated by the use of various flow improving additives also known as middle distillate flow improvers (MDFI) which reduce the CFPP of responsive fuels. One such example is Paraflow® 240 (commercially sold by Infineum). The flow improvers can change the size or the shape of the crystals as they precipitate out of the oil at low temperatures thereby allowing them to pass through the vehicle filter easily and avoid blockage of the fuel filter of the vehicle. Either way, it is important that the flow properties of the fuel oils are maintained.

Hitherto, crude oil was refined into motor gasoline, automotive diesel oils (hereafter "ADO") and gas oils used as heating oils (fuel oils) and their respective specifications were such that it was possible to easily treat ADO, gasoil and heating oils. However, recent legislation to minimise the amount of sulphur and also constrain other properties, eg density, in ADOs has meant that some of the heavier components of ADOs, such as e.g. catalytically cracked heating oils, have been displaced into the gasoil and heating oil fractions. These changes in the composition of ADO, gasoils and heating oils may mean that the effectiveness of conventional cold flow improvers such as Paraflow® 240 is lessened.

It is an object of the present invention to improve the flow properties of fuel oils (as herein defined) containing conventional flow improvers by incorporating therein a heavy-catalytically cracked naphtha.

Accordingly, the present invention is a fuel oil composition having improved cold-flow properties, said composition comprising a cold flow additive and the following components from various pipestill of a petroleum crude refinery process:

- a. a relatively heavy fraction from a catalytically cracked heavy gasoil in turn derived from an atmospheric or vacuum pipestill, said fraction having a boiling range of 170 to 380°C in an amount of 3 to 20% by weight and
- b. a gasoil product from an atmospheric pipestill, said product having a boiling range of 225 to 360°C in an amount of 30-50% by weight,

characterized in that components (a) and/or (b) in said composition is at least partially replaced by at least one relatively light naphtha fraction (c) from the atmospheric or vacuum pipestill, said light fraction (c) having a boiling range of 130 to 235°C and being present in an amount of 3 to 20% by weight, all weights being based on the total weight of the fuel oil composition.

In the fuel compositions of the present invention, the various components referred to are all derivable from various process streams of a petroleum crude refinery process. Such methods are well known in the art and are described in detail for instance by Keith Owen and Trevor Colley in "Automotive Fuels Reference Book", Second Edition, published by the Society of Automotive Engineers, Inc, Warrendale, PA, USA (1995), and specifically to Chapter 3 of this text-book at pages 29-49, Chapter 16 at pages 419-469 and 865-890, the latter pages forming Appendix 12 which is a 'Glossary of Terms' used in this art. Thus, reference to component (a) means a heavy fraction produced by catalytic cracking of heavy gas oil from the atmospheric or vacuum pipestill. This fraction suitably has a boiling point in the range from 184 to 376°C. This fraction is suitably present in the compositions of the present in an amount ranging from about 5-18 % by weight of the total fuel oil composition.

In the fuel oil composition of the present invention, the reference to component (b) means a gasoil product from an atmospheric pipestill which suitably has a boiling point in the range from about 244 to 330°C. This product is suitably present in the

compositions of the present in an amount ranging from about 35-45% by weight of the total fuel oil composition.

5 The third essential component in the fuel oil compositions of the present invention is a light naphtha fraction (c) derived by the catalytic cracking of a heavy gasoil from an atmospheric or a vacuum pipestill. This naphtha fraction (c) suitably has a boiling point in the range from 136 to 231°C and preferably component (a) and/or (b) in the fuel composition in an amount from about 5-15% by weight of the total composition. Fraction (c) suitably has an aromatics content in the range from about 60 - 75% by weight.

10 The fuel oil compositions of the present invention may contain in addition other conventional distillate fractions from a petroleum crude refinery process under atmospheric or vacuum conditions. These include *inter alia* components (d) to (g) described below:

15 (d) a fraction from a vacuum pipestill which suitably has a boiling point in the range from about 200 to 400°C, preferably from about 240-365°C. This fraction (d) is suitably present in the compositions of the present in an amount ranging from about 3-7% by weight, preferably from about 4-6 % by weight of the total composition.

20 (e) a fraction from an atmospheric pipestill which suitably has a boiling point in the range from about 160-380°C, preferably from about 183 to 331°C. This fraction (e) is suitably present in the compositions of the present in an amount ranging from about 5 to 15% by weight, preferably from about 9 to 10% by weight, typically about 9.5-10.0% by weight.

25 (f) a fraction from an atmospheric pipestill which suitably has a boiling point in the range from about 230 -350°C, preferably from about 231 to 344°C. This fraction (f) is suitably present in the compositions of the present in an amount ranging from about 15 to 30% by weight, preferably from about 20-25% by weight.

30 (g) a fraction from an atmospheric pipestill which suitably has a boiling point in the range from about 210-420°C, preferably from about 216 to 395°C. This fraction is suitably present in the compositions of the present in an amount ranging from about 3 to 8% by weight, preferably from about 4-6 % by weight.

The fuel oil compositions of the present invention having an n-paraffin (C<sub>12</sub>+)

content of less than 20% by weight particularly benefit by blending with the light naphtha fraction (c). Such fuel oil compositions suitably have a cloud point of about -3 to -4°C.

The cold flow additive in fuel oil composition is suitably one of those generally available provided it is soluble in the fuel oil composition, although copolymers of ethylene and at least one other unsaturated monomer which may be an additional monoolefin or an unsaturated ester such as eg vinyl acetate, vinyl propionate, vinyl butyrate, ethyl acrylate and lauryl methacrylate or the like. The other unsaturated monomer can also be a mixture of an unsaturated mono-ester or diester and a straight chain or branched chain  $\alpha$ -monoolefin. Mixtures of copolymers, such as eg a copolymer of ethylene and vinyl acetate with an alkylated polystyrene or with an acylated polystyrene, can also be used. Where the flow additive is a copolymer, it suitably consists of 1 to 40, preferably 1 to 20 and more preferably 3 to 20 molar proportions of ethylene per molar proportion of the other unsaturated monomer, said additive copolymer being oil soluble and having a number average molecular weight in the range from about 1,000 to 50,000, preferably about 1,000 to about 5,000. The cold flow additive is preferably an ethylene-vinyl carboxylate copolymer which may be selected from one or more of Paraflow® 240, Paraflow® 226, Paraflow® 222, Paraflow® 275, Paraflow® 255, Paraflow® 223, Paraflow® 332, Paraflow® 209, Paraflow® 206, Paraflow® 480, Paraflow® 482, Paraflow® 479 (all ex Infineum), KF 6100S, KF 6100, KF 6301, KF 6101 (ex BASF), and DF 4842 (ex Clariant).

The cold flow additive is suitably present in the oil composition in an amount from about 0.001-2.0% by weight of the total fuel oil composition.

The surprising feature of the present invention is that component (c), which is a relatively light fraction compared to the distribution of heavier components in fuel oils, is able to improve the effectiveness of conventional cold flow improvers in such fuel oils. It has been found that by using an aliquot of component (c) in the fuel oil compositions, it is possible to depress the cloud point and the temperature of operability, the latter as determined by the cold-filter plugging point (hereafter "CFPP") to a significant extent.

The present invention is further illustrated with reference to the following Examples:



**EXAMPLES:**

The following data was generated by subjecting a variety of fuel oils each of which contained 500 vol/vol ppm of an ethylene-vinyl acetate copolymer (Paraflo® 240, ex Infineum) cold flow additive and a 1050 vol/vol ppm of a gasoil marker dye to a cold flow plugging point (CFPP) test. The test is described in detail in the text-book by Owen & Coley referred to above at pages 422-426 in Chapter 16.1.5. This is an IP 309 test and is also published as a European Standard by CEN, EN116:1981. Briefly, a 40 ml of a sample of the test oil is cooled by a bath maintained at about -34°C. Periodically (at each 1°C drop in temperature starting from not less than 5°C above the cloud point thereof), the cooled oil is tested for its ability to flow through a fine screen in a given time period. This cold flow property is tested with a device consisting of a pipette the lower end of which is attached an inverted funnel positioned below the surface of the test oil. Stretched across the mouth of the funnel is a 350 mesh screen having an area of about 0.45 in<sup>2</sup>. The periodic tests are each initiated by applying a vacuum to the upper end of the pipette whereby oil is drawn through the screen up into the pipette to a mark indicating 20 ml. The test is repeated with each 1°C drop in temperature until the oil fails to fill the pipette up to that 20 ml mark within 60 seconds. The temperature at which the last filtration commenced is recorded as the CFPP.

**TABLE**

Components	Fuel Composition 1* (Wt %)	Fuel Composition 2 (Wt %)	Fuel Composition 3 (Wt %)
Component (g)	4.9	4.9	4.9
Component (e)	9.9	9.9	9.9
Component (a)	16.2	8.4	5.0
Component (c)	-	7.8	15.0
Component (b)	42.2	42.2	38.4
Component (f)	21.8	21.8	21.8
Component (d)	5.0	5.0	5.0
<b>Total</b>	100	100	100
Cloud point (°C)	-3	-4	-4
CFPP (°C)	-8	-10	-15

- 5 The above results show that partially replacing some of the conventional gas oil components in fuel oils with light naphtha fraction from the catalytic cracking of heavy gasoil clearly improves the CFPP of the fuel oils to a significant extent.

**We Claim:**

1. A fuel oil composition having improved cold-flow properties , said composition comprising a cold flow additive and the following components from various pipestill of a petroleum crude refinery process:
  - 5 a. a relatively heavy fraction from a catalytically cracked heavy gasoil in turn derived from an atmospheric or a vacuum pipestill, said fraction having a boiling range of 170 to 380°C in an amount of 3 to 20% by weight and
  - b. a gasoil product from an atmospheric pipestill, said product having a boiling range of 225 to 335°C in an amount of 30-50% by weight,
- 10 characterized in that components (a) and/or (b) in said composition is at least partially replaced by at least one relatively light naphtha fraction (c) from an atmospheric or a vacuum pipestill, said light fraction (c) having a boiling range of 130 to 235°C and being present in an amount of 3 to 20% by weight, all weights being based on the total weight of the fuel oil composition.
- 15 2. A composition according to Claim 1 wherein component (a) has a boiling point in the range from 184 to 376°C.
3. A composition according to Claim 1 or 2 wherein component (a) is present in the
- 20 composition in an amount ranging from about 5-18 % by weight of the total fuel oil composition.
4. A composition according to any one of the preceding Claims wherein component (b) has a boiling point in the range from about 244 to 330°C.
- 25 5. A composition according to any one of the preceding Claims wherein component (b) is present in the composition in an amount ranging from about 35-45% by weight of the total fuel oil composition.
- 30 6. A composition according to any one of the preceding Claims wherein the light naphtha fraction (c) has a boiling point in the range from 136 to 231°C.

7. A composition according to any one of the preceding Claims wherein the light naphtha fraction (c) is present in the composition in an amount from about 5-15% by weight of the total composition.

8. A composition according to any one of the preceding Claims wherein the light naphtha fraction has an aromatics content in the range from about 60 - 75% by weight.

9. A composition according to any one of the preceding Claims wherein the fuel oil composition contains in addition one or more distillate fractions selected from

(d) a fraction from a vacuum pipestill has a boiling point in the range from about 200 to 400°C and is present in an amount ranging from about 3-7% by weight;

(e) a fraction from an atmospheric pipestill which has a boiling point in the range from about 160 to 380°C and is present in an amount ranging from about 5 to 15% by weight;

(f) a fraction from an atmospheric pipestill which has a boiling point in the range from about 230 to 350°C and is present in an amount ranging from about 15 to 30% by weight; and

(g) a fraction from an atmospheric pipestill which has a boiling point in the range from about 210 to 420°C and is present in an amount ranging from about 3 to 8% by weight,

all weights being based on the total weight of the fuel oil composition.

10. A composition according to any one of the preceding Claims wherein the fuel oil composition contains in addition one or more distillate fractions selected from

(d) a fraction from a vacuum pipestill has a boiling point in the range from about 240 to 365°C and is present in an amount ranging from about 3-7% by weight;

(e) a fraction from an atmospheric pipestill which has a boiling point in the range from about 183 to 331°C and is present in an amount ranging from about 5 to 15% by weight;

(f) a fraction from an atmospheric pipestill which has a boiling point in the range from about 231 to 344°C and is present in an amount ranging from about 15 to 30% by weight; and

(g) a fraction from an atmospheric pipestill which has a boiling point in the range from about 216 to 395°C and is present in an amount ranging from about 3 to 8% by weight,  
all weights being based on the total weight of the fuel oil composition.

5

11. A composition according to any one of the preceding Claims wherein the cold flow additive is present in said composition in an amount from 0.001 to 2.0% by weight of the total fuel oil composition.

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12. A composition according to any one of the preceding Claims wherein the cold-flow additive is an ethylene vinyl acetate copolymer.

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13. A method of improving the cold flow properties of a fuel oil composition comprising a cold flow additive and the following components from various pipestill of a petroleum crude refinery process:

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- a. a relatively heavy fraction from a catalytically cracked heavy gasoil in turn derived from an atmospheric or vacuum pipestill, said fraction having a boiling range of 180 to 380°C in an amount of 3 to 20% by weight and
- b. a gasoil product from an atmospheric pipestill, said product having a boiling range of 240 to 335°C in an amount of 30-50% by weight,

25

said method comprising replacing at least partially components (a) and/or (b) in said composition by at least one relatively light naphtha fraction (c) from an atmospheric or a vacuum pipestill, said light fraction (c) having a boiling range of 130 to 235°C and being present in an amount of 3 to 20% by weight, all weights being based on the total weight of the fuel oil composition.

**ABSTRACT OF DISCLOSURE**

This invention relates to a fuel oil composition having improved cold-flow properties and comprising a cold flow additive and streams from various pipestills of a petroleum crude refinery process:

- a. a relatively heavy fraction from a catalytically cracked heavy gasoil in turn derived from an atmospheric or vacuum pipestill, said fraction having a boiling range of 170 to 380°C in an amount of 3 to 20% by weight and
- b. a gasoil product from an atmospheric pipestill, said product having a boiling range of 225 to 360°C in an amount of 30-50% by weight,

whereby components (a) and/or (b) is at least partially replaced by at least one relatively light naphtha fraction (c) from the atmospheric or vacuum pipestills, fraction (c) having a boiling range of 130 to 235°C and being present in an amount of 3 to 20% by weight.